Science Toolkit: Grade 7 Objective 6.A.1.a

Student Handout: Science: Grade 7 Objective 6.A.1.a

Standard 6.0 Environmental Science

Topic A. Natural Resources and Human Needs

Indicator 1. Recognize and explain the impact of a changing human population on the use of natural resources and on environmental quality.

Objective a. Based on data identify and describe the positive and negative impacts of an increasing human population on the use of natural resources

Selected Response (SR) Item

Question

Use the technical passage below to answer the following:

Waste Not: Energy from Garbage and Sewage

A hundred years ago, gas was collected from rotting sewage and used to light streetlamps. New technologies hope to update this concept—tapping garbage as well as human waste—for an energy-hungry world.

One promising device is called a microbial[1] fuel cell. It makes electricity much like a hydrogen fuel cell,[2] but it runs off wastewater. Sewage-eating bacteria drive a chemical process that generates current and, as a bonus, helps purify the water.

Bruce Logan of Pennsylvania State University and his colleagues have constructed small microbial fuel cells, no bigger than a can that can power various devices, including a small fan.

"If you had 100,000 people and you treat their sewage, you could get up to 2.3 megawatts of continuous power, which is enough to supply electricity for 1,500 homes," Logan said. A megawatt is one million watts.

A self-sufficient water-treatment device is also something that NASA is interested in. Bruce Rittman of Northwestern University is currently devising a microbial fuel cell that could be used on manned space missions.

"You have to recycle everything up in space," Rittman said. "You want to capture food waste and human waste, as well as recycle water."

A microbial fuel cell has some advantages over the more traditional method, called an anaerobic digester,[3] which collects the methane, or "biogas," that bacteria belch out when they consume organic material in the absence of oxygen. The methane is later burned to turn a turbine generator.

"Instead of going through the intermediate step of combustion,[4] a cell makes the electricity directly," Rittman said.

This direct route means that a microbial fuel cell could potentially extract more energy from a given amount of sewage. It also would avoid the pollution that burning methane produces.

But both Rittman and Logan are quick to add that cells are still early in development, whereas digesters are in use, mostly in agriculture settings where the concentration of organic material is higher than from urban sewers.

[1]microbial – pertaining to very small organisms, such as bacteria

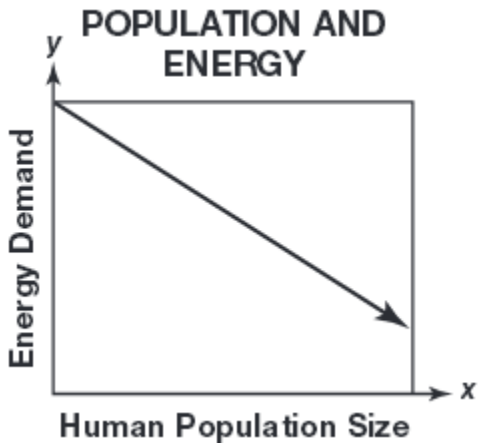
[2]hydrogen fuel cell – a device that uses hydrogen to produce electricity

[3]anaerobic digester – a container where plant or animal material decomposes without oxygen

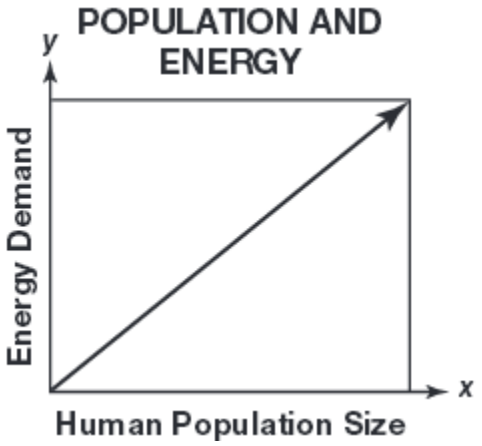
[4]combustion – burning

Which graph <u>best</u> displays the relationship between human population size and energy demand?

A.



B.



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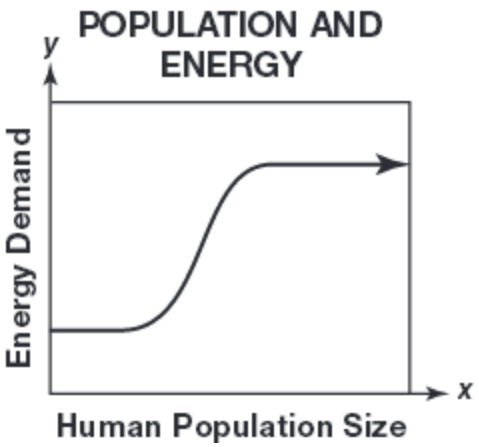
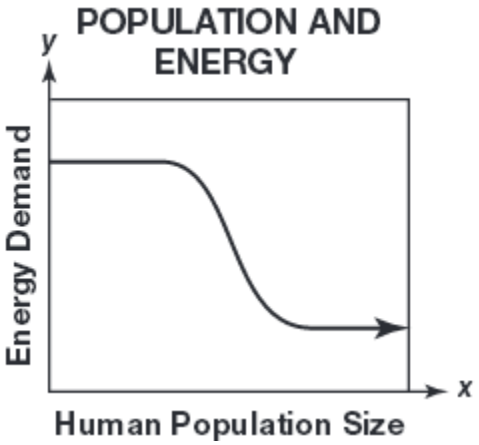
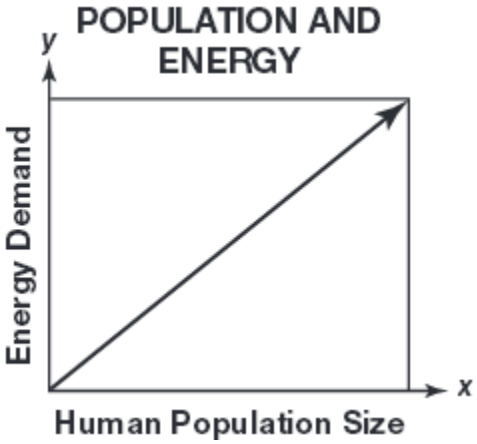


D.



Correct Answer

B.



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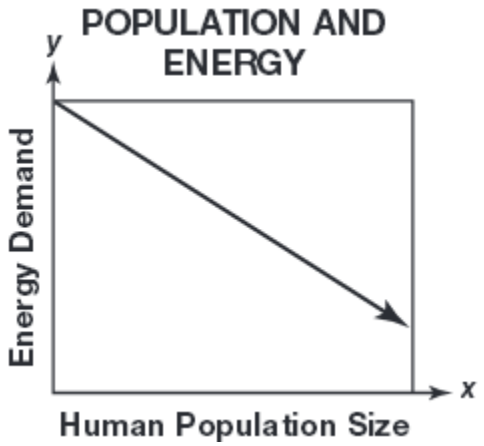
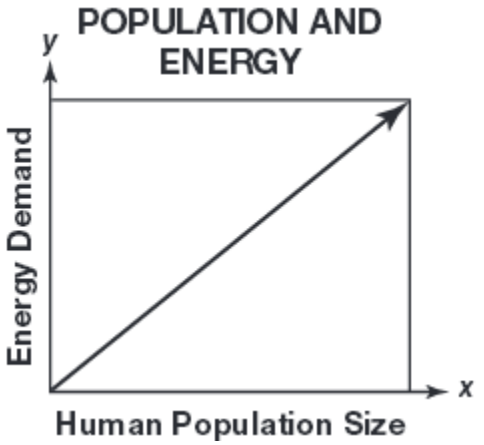

POPULATION AND ENERGY
y
Energy Demand
x
Human Population Size

B.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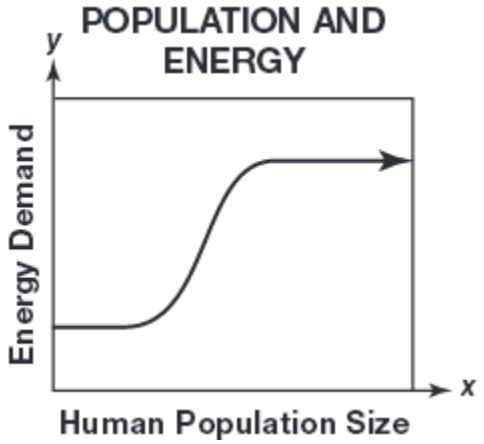
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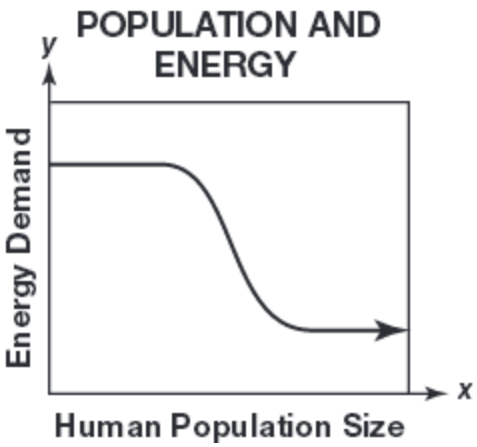
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